Ecoregional Conservation Planning in the Marine Environment

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Abstract
The Washington Department of Fish and Wildlife (WDFW) has identified a need for large-scale planning that will lead to effective and efficient conservation of the state's fish and wildlife. WDFW is working closely with The Nature Conservancy (TNC) on Ecoregional Conservation Assessments to develop a portfolio of sites to conserve biological diversity. The portfolio will consist of a network of "conservation sites" which, if properly managed, should conserve most of an ecoregion's biological diversity in a cost-efficient manner (a minimum set of reserves). The process is data intensive. Data are compiled for both coarse filter (communities) and fine filter (species) targets including: known locations of occurrences, land cover maps, habitat maps, land ownership, and other spatial data. This approach to conservation of resources, through protection of biodiversity, represents a departure from historic species by species management. The relationship between these two approaches is discussed.

Background
Management of the fish and wildlife resources has undergone an evolution from ancient times to our current way of thinking. Gilbert (1971) traces the history through several recognizable "eras" with significant changes in attitude towards the natural resources themselves, including the concept that wildlife are a "trust" resource (dating back to the period of the English Magna Carta) through the introduction of the modern conservation principles founded by people such as Gifford Pinchot and Theodore Roosevelt. Certainly writers such as Aldo Leopold did much to connect the production of wildlife to the preservation of habitat in the public mind (Leopold, 1949). Today, protection of habitat is widely accepted as a vital portion of wildlife management.

While wildlife is publicly owned, a large portion of the land area in Washington State is under private ownership. By some calculations, 41% of the surface lands in Washington are under state or federal ownership (National Wilderness Institute 2003) while the remaining 59% are privately held. Given the amount of privately owned lands, some of the primary tools to protect wildlife habitat have been land acquisition, land covenants and land use planning.

The need for the preservation of habitat to provide an adequate production base for the wildlife species of Washington State is closely tied to the increasing human population. The Puget Sound Water Quality Action Team (PSWQAT) estimates that "The population of the Puget Sound and the Georgia Basin is expected to grow by two million (with) in the next 20 years." They put this in context by stating that: "This is equivalent to adding more than twenty new cities the size of Everett or more than ten the size of Tacoma, with all the houses, businesses, roads, water supplies, sewer discharges, industries and recreation areas this growth will demand." (PSWQAT 2003). This growth in human population is likely to translate directly into pressures for further reductions in open spaces and lands for wildlife. As a result, the need for a scientifically based planning tool to assist decision makers regarding growth management, land uses, land protection and potential public land acquisitions has never been greater.

In response to this need, the Washington Department of Fish and Wildlife (WDFW) developed the "Priority Habitats and Species (PHS)" program to help planners respond to increasing pressures from human populations and to promote habitat protection. This program, initiated in 1989, compiles comprehensive information on important fish, wildlife, and habitat resources in Washington and provides this information to local governments, state and federal agencies, private landowners and consultants, and tribal biologists for land use planning purposes (WDFW 2003).

Development of Ecoregional Conservation Planning
The combination of privately owned lands, the increasing human populations, and the need to protect viable wildlife populations has led to the development of additional tools for the prioritization of actions. The Nature Conservancy (TNC) has developed an approach entitled Ecoregional Conservation Planning (ECP) to further prioritize lands for protection and management actions. This phrase, originally coined within TNC (Groves et al. 2000), is used to describe the process of selecting and designing networks of conservation sites that, if properly managed, should conserve most of an ecoregion's biological diversity in a cost-efficient manner (with a minimum set of reserves) for perpetuity. The unique aspects of ECP are that it attempts to take the overall viability of target wildlife species into account in the selection of a group of locations (called a conservation "portfolio") that will ensure the continuation of biodiversity within an ecoregion.

The selection of these conservation portfolios is a complex, data driven exercise that uses a computer program known as "SITES." This program, developed with TNC funding by UC Santa Barbara, is an optimization, annealing algorithm designed to help in the efficient selection of conservation sites (The Nature Conservancy 2003). The SITES algorithm allows users to influence the results in the three areas of target goals, boundary connectivity, and overall costs. Target conservation goals are broken into two types designated "coarse" and "fine." The "coarse" targets represent regional habitat types (plus their modifiers) and most target species are included via selection of these representative habitats. "Fine" targets, on the other hand represent, individual species that were not captured sufficiently by the habitat targets. The boundary function is used to increase (or decrease) the clustering of the areas selected (and therefore connectivity) and the cost-component can be used to assess factors such as the effort required to restore functionality, proximity to development, etc. The process also uses expert input throughout the development to review the portfolio and ensure completeness.

Historic Fishery Management

The history of fishery management has taken a somewhat different course from that of wildlife management. Since the marine waters and "lands" (i.e. submerged lands or bedlands) where fisheries have been pursued are publicly owned and are managed, in trust, for the citizens as well as for future generations (Slade et al. 1997), the acquisition of the habitat has not been a major focus. Consequently, habitat protection has been a relatively minor portion of fishery management strategy and has focused primarily upon vulnerable resources such as intertidal spawners (e.g.. smelt and herring) and sedentary species (e.g. bivalve shellfish) that may be affected by water quality changes.

Fishery management originally developed around the mathematics of dealing with exploited populations, and the science included a variety of equations used to calculate various population parameters. These are reviewed and summarized in a variety of texts (e.g. Lackey and Nielsen 1980, and Gulland 1977). Current fishery managers, however, recognize that these early models were inadequate in their scope and that each of these parameters needs to be calculated in a more realistic way (Barker 2003) and while fishery management has improved through the use of more responsive calculations of population parameters, the focus has continued to be on the science and mathematics of estimating individual populations of fish and the calculation of acceptable exploitation rates. Ecosystem-related approaches are being developed, which attempt to deal with multiple variables and to account for factors such as environmental changes and species interactions although most management in actual use still focuses on individual species or stocks (FAO 2002).

Throughout the evolution of fishery management, there has been a basic, underlying assumption that the habitat base producing the resource will continue to be present. Managers have assumed that this habitat will continue producing the populations of interest, and management was only related to control of harvests. Fish stocks were treated as units as they occurred throughout the public trust area, regardless of location.

Fishery management, as practiced in recent years, has led to significant collapses of a number of fish stocks worldwide (FAO 2002). Regional and local fish stocks have also experienced similar declines (PFMC 2000; Palsson et al. 1997). The most recent development in fishery management has been a growing body of literature that points out the potential benefits of establishing a network of "reserve" areas, defined internationally as locations permanently closed to fishing (The Partnership for Interdisciplinary Studies of the Coastal Oceans 2002; Gell and Roberts 2003).

WDFW Development Of Statewide Conservation Plan

In Washington State, both wildlife and fishery management are facing increasing problems. Protection of wildlife production and diversity is faced with continued increases in human populations while collapses of fish stocks have affected fishers and communities. Some people relate both types of problems to the focus on individual species with insufficient attention being paid to biodiversity. Last year (2002), the Washington State Legislature referred to these issues in Substitute Senate Bill (SSB) 6400. This bill called for the creation of a biodiversity conservation strategy and stated that this was to be developed specifically as an alternative to single species management (Washington State Legislature, Sec. 1, Chap. 287, Laws of 2002).

WDFW is currently developing a statewide conservation plan with completion projected to be 2005. Upon reviewing similar attempts underway elsewhere, it was decided to adopt the methodology being developed by The Nature Conservancy (TNC) for use in its "Ecoregional Conservation Planning" (ECP) program. Fortuitously, TNC had began implementing their ECP strategies within Washington State approximately two years ago (circa 2000) and it is WDFW's expressed intention to be actively involved in the ECP analysis within Washington State ecoregions and to use the results of this analysis to form the foundation for its' own statewide conservation plan. The first step in developing an ecoregional plan is the production of the portfolio of areas or locations. Participants are referring to this portion of the

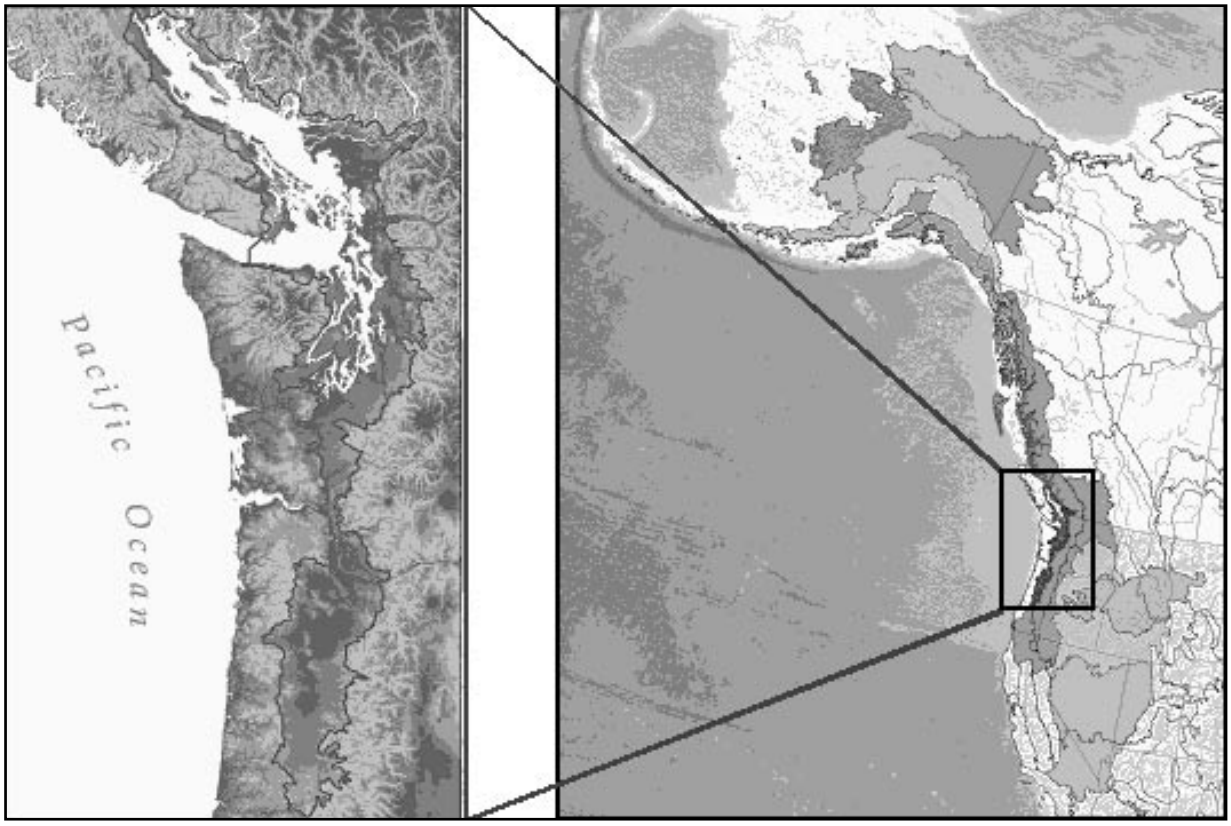

Figure 1. Willamette Valley - Puget Trough - Georgia Basin (WPG). Maps courtesy of Zach Ferdaña, TNC.

analysis phase of this project as "Ecoregional Conservation *Assessment*" to indicate that more work will be done to produce an Ecoregional Plan.

Draft Portfolio Of Sites Developed

TNC, in partnership with a variety of agencies and NGOs, has been developing conservation "portfolio" within the Willamette Valley-Puget Trough-Georgia Basin (WPG) ecosystem (Figure 1). Zach Ferdaña is presenting this draft portfolio of areas concurrently at this conference (Ferdaña 2003). This portfolio is a groundbreaking integration of marine and upland areas in a single land-use planning tool.

For optimal results the SITES model requires spatially continuous datasets. This is often difficult to find within marine waters as the available data have often been collected to answer specific location-related questions, and application of these data on a larger scale would entail significant assumptions. Even habitat data (depth, substrate type, vegetation, salinity and currents) tend to be discontinuous and patchy.

The most regionally comprehensive marine habitat datasets that were used came from the shoreline classification surveys that existed in both Canada and Washington. These datasets were based on the Canadian shoreline classification effort that utilized aerial surveys to identify substrate and vegetation types along the British Columbia coast. The Washington Department of Natural Resources (DNR) completed a similar project a few years ago using helicopter flights and video cameras to survey the entire Washington coastline. When compiled, this represented a comprehensive dataset, collected using similar methods and scales that spanned the international boundary and the ecoregion.

The Puget Sound /Georgia Basin marine analysis utilized the above shoreline data and selected resource datasets. The analysis was data limited to a depth of 40m below mllw. Portfolio selection was an iterative process based upon successive SITES runs and expert review.

Relationship to Fishery Management

Generation of this portfolio leads to a variety of issues for discussion. One of these issues is the relationship between the portfolio of the conservation sites and currently existing protection criteria. The species covered by PHS are all considered sensitive and as such require protection. Particularly in marine waters, these resources and the habitats upon which they depend are all part of the public trust. Selection of areas by the SITES model was based on high biodiversity. Inclusion of some of these conservation areas in the draft portfolio does not lessen the public trust responsibilities incumbent on the trust agencies (e.g. WDFW and DNR) for these resources wherever they occur. These areas now receive some protection and this should continue. The intended outcome of the planning effort is not to reduce the protection offered to such species but to provide additional focus on key diversity areas. In marine waters, the type of protection that might be offered in these areas is yet to be defined and should be dependent on an analysis of the threats to the area and the resources present.

A second issue under discussion is the relationship of the portfolio to historic fishery management. SSB 6400 described biodiversity planning as an alternative to single species management. The potential influence of protection of the portfolio sites on the harvested species needs to be explored. The following comments are predominantly conceptual but are included to illustrate the type of analysis of interest to fishery managers relative to biodiversity protection.

Discussion of the potential analyses can be discussed in the terms of the Baranov Catch function:

$$C = N\frac{F}{F+M}A$$

(Baranov Catch Function after Tyler and Galluci, 1980)
Where:
C = Catch in numbers of fish
N = Stock in numbers of fish
F = Instantaneous fishing mortality
M = Instantaneous natural mortality
A = Proportionate mortality rate

If species-specific areas of protection or larger ecological reserves are to be related to fishery management (and to catch or harvest), the factors they must influence in this equation are “M,” natural mortality or “F,” fishing mortality.

Conceptually there could be ways that “M” for the harvested species might be affected by protection of biodiversity areas (e.g. habitat protection for critical life history phases of the harvested species or protection of food sources for the harvested species). Certainly, reduction of fishing pressure would affect “F.” If the goal is to influence “F” through the protection of certain areas, the criteria for selecting these areas will be tied to the harvested organisms rather than to biodiversity.

But to make an effective argument that protection of certain areas will have a relationship to overall harvest of the species, the action taken will need to affect the population of the harvested resource as a whole. To affect “C” (the catch of the harvested species), the influence of the protection granted would have to extend to areas outside the reserve (protected area) and be large enough to affect the overall population of the stock. Various mechanisms for this have been hypothesized and, in some cases, measured such as larval export, “spillover” of adults, etc. (The Partnership for Interdisciplinary Studies of the Coastal Oceans 2002; Gell and Roberts 2003).

However, producing an effect on an entire exploited population by protection of biodiversity sites may be difficult to produce and very difficult to measure. In addition, the interests of the resource users in the analysis of the need for protection of certain areas are likely to be specific to the resource they exploit. Despite the shortcomings of species by species fishery management, many knowledgeable harvesters are likely to seek this type of analysis relating to their species of interest. Given these difficulties, this approach is not likely to be an adequate substitute for traditional species by species management.

Fishery management and biodiversity protection have two different goals and are designed to perform very different functions. Fishery management is designed to protect a reproductively viable population while allowing continuing harvest of a portion of the resource. Biodiversity management is designed to protect a core of all areas and all species, such that all will continue indefinitely at some level. The continuation of these species is not related to production levels

above species viability. Biodiversity conservation is not designed to protect sufficient production of the species (nor the habitat required to sustain this level of production) to permit removal or harvest of the species as well.

Both types of management may use protection of key habitats to achieve their respective goals but the areas selected are likely to be strongly influenced by the goals of the management type. Fishery management has not protected biodiversity in the past. By the same token, protection of biodiversity as a goal may not be adequate alone to manage harvested species. One is not likely to substitute for the other.

While the two approaches do not have the same goals, they are not necessarily in conflict. The draft Conservation Plan for Resources and Fisheries in Puget Sound (WDFW, in press) includes recommendations for multiple types of marine protected areas. This draft plan recommends focusing first upon habitats that are likely to offer benefits to stressed populations (such rocky reefs for rockfish) followed by the creation of "Ecological Diversity Marine Protected Areas (MPAs)" designed for use by a variety of species. While this latter concept is not defined in detail by this plan nor are the specific protections that would be needed discussed, the issue was included conceptually to relate to the protection of biodiversity.

The draft portfolio of ecoregional sites may be of value in the design of the Ecological Reserves. The portfolio includes rigorous criteria for selection of target species and is data intensive with incorporation of expert input along with the best data available. The protection needed for these biodiversity sites must be further defined before the potential benefits can be delineated.

Conclusion

Ecoregional Conservation Planning (and Assessment) is a major step forward towards a data-driven, science-based approach to selection of a portfolio of biodiversity areas. In marine waters, the challenge for managers will be to relate biodiversity planning and protection to the improving technology in fishery management. Developing this relationship will be needed both to pass the scientific scrutiny of ecologists and resource managers, and to earn the trust of resource users. Meeting this challenge will rest on the relationship between the network of ecological reserves and the management and conservation of individual species. The goals (diversity protection and management of harvest) can be complementary but need to be integrated by managers to provide better and more holistic management of the trust resources. Holistic management should entail using the best tools available in both styles of management.

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